PTO/SB/05 (12/97)
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69302 U.S. PTO 04/28/00

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	*Total Pages*
998/Z7041DBA	

First Named Inventor or Application Identifier

Chikanori MIZUNO

Express Mail Label No.

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
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1. [X] Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. [X] Specification [Total Pages 20]
(preferred arrangement set forth below)

- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 USC 112)* *[Total sheets - 14]*

4. Oath or Declaration *[Total Pages - 3]*

a. [X] Newly executed (original or copy)
b. [] Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]
i. [] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. [] Incorporation By Reference
(usable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. [] Microfiche Computer Program *(Appendix)*

7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. [] Computer Readable Copy
b. [] Paper Copy (identical to computer copy)
c. [] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [X] Assignment Papers (cover sheet & document(s))
9. [] 37 CFR 3.73(b) Statement [] Power of Attorney
(when there is an assignee)
10. [] English Translation Document *(if applicable)*
11. [] Information Disclosure Statement (IDS)/PTO-1449 [] Copies of IDS Citations
12. [] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503)
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14. [X] Small Entity Statement(s)
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18. CORRESPONDENCE ADDRESS

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of : Attn: APPLICATION BRANCH

Chikanori MIZUNO : Docket No. 998/Z7041DBA

Serial No. [Not yet assigned] :

Filed April 28, 1998 :

METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN :

PATENT OFFICE FEE TRANSMITTAL FORM

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Attached hereto is a check in the amount of $435.00 to cover Patent Office fees relating to filing the following attached papers:

New application	$ 395.00
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Respectfully submitted,

Chikanori MIZUNO et al.

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METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN

BACKGROUND OF THE INVENTION

1.Field of the invention

This invention relates to a method of electroplating tubular workpieces and more specifically, an inner surface of a bent tubular workpiece, and an auxiliary anode element suitable for use in the method.

2.Description of the prior art

In electroplating, generally, an anode element and a workpiece to be electroplated are immersed in a plating liquid containing plating metal ions. Electric current is supplied between the anode element and the workpiece serving as a cathode element so that the workpiece is electroplated. When the workpiece is tubular, the inside of the workpiece is concealed from the anode element such that a sufficient amount of current flow for the plating is not obtained inside the tubular workpiece. Accordingly, an inner surface of the tubular workpiece has an extremely lower degree of plating than an outer surface thereof.

To improve non-uniformity in the current flow distribution as described above, the prior art has provided use of an auxiliary anode element. The use of the auxiliary anode element is effective when the tubular workpiece is straightforward in its shape. In this case, the workpiece is placed upright in the plating liquid reserved in a plating

bath, and the auxiliary anode element is inserted into a hollow interior of the workpiece so as to be concentric therewith. However, the auxiliary anode element has been found ineffective for a bent tubular workpiece which is bent or curved at one or more portions in the middle thereof.

To plate the bent tubular workpiece, the prior art has provided a hot dipping in which the workpiece is immersed in a molten solder with a low melting point etc. to be plated. In this method, however, the solder is hardened, dropping from ends of the workpiece. As a result, the hardened solder projects from the ends of the workpiece and a later mechanical finishing is required to remove projections of hardened solder. This complicates the plating process.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a method of electroplating in which the tubular workpieces and particularly the inner surface of the bent tubular workpiece can sufficiently be electroplated , and an auxiliary anode element suitable for use in the method.

The invention provides a method of electroplating a tubular workpiece comprising the steps of inserting a flexible linear auxiliary anode element into a hollow interior of the workpiece so that the auxiliary anode element is insulated from an inner peripheral surface of the workpiece, immersing the workpiece and the anode element in a plating liquid reserved in a plating bath, and applying

voltage between the auxiliary anode element and the workpiece.

An insulating spacer is preferably attached to the auxiliary anode element so that a liquid penetrating space is defined between the auxiliary anode element and the inner peripheral surface of the workpiece. The auxiliary anode element with the insulating spacer attached thereto is preferably inserted into the workpiece.

Since the auxiliary anode element has flexibility, the anode element is inserted into the hollow interior of the workpiece, bent according to a shape of the workpiece. Furthermore, since the auxiliary anode element is provided with the insulating spacer, the element is prevented from coming into direct contact with the inner surface of the workpiece. Consequently, since the current distribution is improved inside the workpiece, satisfactory plating can be obtained. Furthermore, since plating defect due to the contact of the auxiliary anode element with the workpiece is eliminated, the inner surface of the workpiece can desirably be electroplated. Additionally, no special aftertreatment as in the conventional plating is required.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become clear upon reviewing the following description of preferred embodiments thereof, made with reference to the accompanying drawings, in which:

FIG. 1 is a schematic longitudinal section of a plating bath employed in the method of a first embodiment in accordance with the present invention;

FIG. 2 is a perspective view of a hanger employed in the method;

FIG. 3 illustrates a filler pipe suspended from the hanger;

FIG. 4 is a partially cut away perspective view of an auxiliary anode element;

FIG. 5 is a sectional view of the filler pipe into which the auxiliary anode element is inserted;

FIG. 6 is a partially cut away perspective view of the auxiliary anode element employed in the method of a second embodiment;

FIG. 7 is a partially enlarged perspective view of the auxiliary anode element;

FIG. 8 is a sectional view of the filler pipe into which the auxiliary anode element is inserted, in the second embodiment;

FIG. 9 is a partially cut away perspective view of the auxiliary anode element employed in the method of a third embodiment;

FIG. 10 is a partially cut away perspective view of a coil constituting the insulating spacer;

FIG. 11 is a sectional view of the filler pipe into which the auxiliary anode element is inserted, in the third embodiment;

FIG. 12 is a partially cut away perspective view of the

auxiliary anode element employed in the method of a fourth embodiment;

FIG. 13 is a perspective view of the insulating spacer employed in the fourth embodiment;

FIG. 14 is a sectional view taken along line 14-14 in FIG. 13; and

FIG. 15 is a sectional view of the filler pipe into which the auxiliary anode element is inserted, in the fourth embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the present invention will be described with reference to FIGS. 1 to 5. In the first embodiment, the invention is applied to a case where a filler pipe 1 connected to a gasoline tank inlet of an automobile is galvanized. The filler pipe 1 is made of a steel material and includes an inlet 2, a straightforward portion extending from the inlet 2, and a reduced diameter portion further extending from the straightforward portion. The reduced diameter portion of the filler pipe 1 is bent in its midway at an obtuse angle to one side. The filler pipe 1 is further bent at its distal end approximately at a right angle. A venting auxiliary pipe 3 comprising a small pipe requiring no plating is welded to the inlet 2.

The filler pipe 1 is hung on a hanger 5 further suspended from a circulation line. The hanger 5 will be described in detail later. The filler pipe 1 is conveyed along the line

to be treated sequentially at a preparation step including degreasing, cleaning, etc., a galvanizing step as will be described later, and an aftertreatment step including cleaning, chromate treatment, drying, etc. The filler pipe 1 is completed through these treatment steps as a galvanized product.

FIGS. 2 and 3 illustrates the above-described hanger 5. The hanger 5 comprises a cathode side frame 6 and an anode side frame 14 integrally assembled together. The filler pipe 1 is hung on the cathode side frame 6. The cathode side frame 6 is made of an electrically conductive metal into a vertically long shape. The cathode side frame 6 has a first hook 10 protruding from a lower end thereof and a second hook 11 formed at an upper end thereof. The filler pipe 1 is put on the hook 10. Only the first hook 10 and the second hook 11 (meshed in FIG. 2) of the frame 6 are bared for electrical conduction, and an insulating coating is applied to the other portion of the frame 6. A cathode bar 12 is fitted with the second hook 11. The hanger 5 is suspended via the cathode bar 12 from the line.

The anode side frame 14 is provided for hanging an auxiliary anode element 20 as will be described later. The anode side frame 14 is also made of the conductive metal. The anode side frame 14 has a bent mount 15 provided at a lower end thereof. The mount 15 has a screw hole 17 with which a bolt 16 is threadingly engageable. The mount 15 further has an obliquely projecting contact piece 18 formed at an upper end thereof. Only the mount 15 and the contact

piece 18 of the anode side frame 14 are bared for electrical conduction as shown in meshes in FIG. 2, and an insulating coating is applied to the other portion of the frame 14. The cathode side frame 6 and the anode side frame 14 are bound back to back by wires so as to be integrally assembled together to be insulated from each other.

The auxiliary anode element 20 will now be described. As shown in FIG. 4, the auxiliary anode 20 comprises a metal wire 21 and an insulating spacer 22. The metal wire 21 is formed by stranding a number of stainless steel wires and has flexibility. The metal wire 21 is inserted into a hollow interior of the filler pipe 1 with a clearance between it and the inner circumference of the pipe. A terminal member 23 is secured to an end of the metal wire 21. The terminal member 23 has an insertion hole 24 for the bolt 16.

The insulating spacer 22 is made of a non-conductive material such as synthetic resin into the shape of a disk having a central through hole 22A. The metal wire 21 is inserted through the central hole 22A so that the insulating spacer 22 is fitted with the metal wire 21.

A plating bath 30 is provided at the galvanizing step as shown in FIG. 1. A predetermined amount of plating liquid 31 is reserved in the plating bath 30. The plating liquid 31 contains 20 g/l of zinc (Zn), 60 g/l of sodium hydroxide (NaOH), and 50 g/l of sodium cyanide (NaCN). The temperature of the plating liquid 31 is maintained in a range between 25 and 30 C (cyanic bath). The plating liquid may be a zincate bath which does not contain sodium cyanide.

Two zinc plates 32 are hung down at opposite sides in the plating bath 30 so as to be immersed in the plating liquid 31. The zinc plates 32 are connected to anodes of a power supply system (not shown) respectively. The hanger 5 on which the filler pipe 1 is mounted is immersed in the plating liquid 31 in the central interior of the plating bath 30. When the hanger 5 is immersed in the plating liquid 31 in the plating bath 30, the cathode bar 12 connected to the cathode side frame 6 is conductively connected to an anode of the power supply system. The anode side frame 14 is conductively connected via the contact piece 18 to an anode of the power supply system.

In execution of the galvanization, the terminal member 23 of the metal wire 21 is conductively fixed to the mount 15 of the anode side frame 14 by the bolt 16 as shown in FIG. 3. A suitable number of the insulating spacers 22 is then fitted with the periphery of the metal wire 21. As a result, the auxiliary anode element 20 is hung on the anode side frame 14. The filler pipe 1 is racked by the hanger 5 at a predetermined racking position. In this case, a free end of the auxiliary anode element 20 is first inserted through the inlet 2 into the filler pipe 1. Then, the flexible metal wire 21, bent according to the bent form of the filler pipe 1, is inserted with the insulating spacers 22 being fitted with the filler pipe at predetermined positions, as shown in FIG. 5. Consequently, the metal wire 21 is inserted in the filler pipe 1 approximately at the center of the hollow interior of the

pipe without contact with the inner surface of the pipe.

The auxiliary pipe 3 is then hung on the first hook 10 such that the filler pipe 1 is suspended from the hanger 5. When two filler pipes 1 are to be suspended in a vertical alignment, a single longer auxiliary anode element is provided so that the auxiliary anode element is inserted into both filler pipes 1.

Upon completion of the racking, the filler pipe 1 suspended from the hanger 5 is carried along the line so that the above-described preparation steps including degreasing, cleaning, etc. are sequentially executed. Upon completion of the preparation steps, the filler pipe 1 is transferred to the galvanizing step. The filler pipe 1 suspended from the hanger 5 is immersed in the plating liquid 31 reserved in the plating bath 30. The cathode bar 12 connected to the cathode side frame 6 is further connected to the cathode of the power supply system, whereas the anode side frame 1 is connected via the contact piece 18 to the anode of the power supply system. As a result, an electric current is caused to flow from the zinc plates 32 and the metal wire 21 both connected to the anode to the filler pipe 1 connected to the cathode, whereupon the outer and inner surfaces of the filler pipe 1 is galvanized. The galvanizing steps is executed for twenty and several minutes.

Upon completion of the galvanizing step, the above-described aftertreatment step including cleaning, chromate processing, drying, etc. are sequentially executed for the filler pipe 1. The filler pipe 1 is completed through these

steps as a galvanized product.

According to the foregoing embodiment, the auxiliary anode element 20 is inserted into the filler pipe 1 when the filler pipe 1 having the vent portions is galvanized. Consequently, the inner surface of the filler pipe 1 can sufficiently be galvanized as well as the outer surface thereof. More specifically, since the metal wire 21 is flexible, the metal wire, bent according to the bent form of the filler pipe 1, is inserted into the filler pipe 1. Furthermore, since the insulating spacers 22 are fitted with the filler pipe 1, the metal wire 21 can be prevented from coming into direct contact with the inner surface of the filler pipe. Consequently, the current flow distribution in the hollow interior of the filler pipe 1 is improved such that a sufficient plating (plated coating) thickness can be obtained. Furthermore, the inner surface of the filler pipe 1 can sufficiently be galvanized without non-plated portions due to the contact of the metal wire 21 with the inner surface of the filler pipe 1. The inventor has confirmed that the same coating thickness by the plating can be obtained on the inner surface of the filler pipe as on the outer surface thereof. Additionally, since no later mechanical finishing as necessitated in the conventional hot dipping is required, the manufacturing step of the filler pipe can be simplified and accordingly, the manufacturing cost thereof can be reduced.

FIGS. 6 to 8 illustrate a second embodiment of the invention. The second embodiment relates to an improvement

in the auxiliary anode element. An auxiliary anode element 40 used in the second embodiment is constituted as shown in FIG. 6. More specifically, the auxiliary anode element 40 includes the same metal wire as that of the element 20 in the first embodiment. A cylindrical member 41 is secured to the distal end of the metal wire 21 to collect the stainless steel wires thereof together. A vinyl tube 42 constitutes the spacer in the second embodiment. The vinyl tube 42 has a number of openings 43 formed in a circumferential face thereof in lines. The metal wire 21 is fitted in the vinyl tube 42. The vinyl tube 42 is fixed to an attachment 44 at one end side of the metal wire 21, whereas it is crushed at the other end side of the metal wire 21 to be melted.

When the auxiliary anode element 40 is inserted into the filler pipe 1, the metal wire 21 is, bent together with the vinyl tube 42 according to the bent form of the filler pipe 1, is inserted into the filler pipe 1, as shown in FIG. 8. The vinyl tube 42 is partially brought into contact with the inner surface of the filler pipe 1 and accordingly, the metal wire 21 is prevented from a direct contact with the inner surface of the filler pipe 1.

The current flow distribution in the hollow interior of the filler pipe 1 is also improved when the filler pipe 1 is galvanized using the auxiliary anode element 40. Consequently, a sufficient coating thickness by the galvanization can be obtained. Furthermore, the inner surface of the filler pipe 1 can also be galvanized sufficiently without non-plated portions due to the contact

of the metal wire 21 with the inner surface of the filler pipe 1. Additionally, since the auxiliary anode element 40 has almost no portions to be caught, it can smoothly be inserted into the filler pipe 1.

FIGS. 9 to 11 illustrate a third embodiment of the invention. An auxiliary anode element 50 includes a spacer comprising a plurality of coils 51 in the third embodiment. Each coil 51 is made of a base material or a wire material 54 as shown in FIG. 10. The wire material 54 is formed by covering a steel wire 52 with a resin tube 53. The wire material 54 is then wound helically into a cylindrical shape with a predetermined length. Since the wire material 54 is covered with an insulating sheath, each coil 51 is electrically non-conductive. Furthermore, an opening is formed between each turn of the wire material 54 and the adjacent one.

A cylindrical cushion member 56 with elasticity is fitted with the proximal end of the metal wire 21. Thereafter, a plurality of coils 51 are sequentially fitted with the metal wire 21. A stopper 57 is finally fastened to the distal end of the metal wire 21 for preventing the coils 51 from falling off. Thus, the auxiliary anode element 50 is constituted including the coils 51 continuously fitted with the metal wire 21 as shown in FIG. 9. When the auxiliary anode element 50 is inserted into the filler pipe 1, the metal wire 21 is suitably curved between the coils to be bent according to the bent form of the filler pipe 1, as shown in FIG. 11. The coils 51 are partially brought

into contact with the inner surface of the filler pipe 1 and accordingly, the metal wire 21 is prevented from a direct contact with the inner surface of the filler pipe 1.

The current flow distribution in the hollow interior of the filler pipe 1 is improved as in the first embodiment. Consequently, a sufficient coating thickness by the galvanization can be obtained. Furthermore, the inner surface of the filler pipe 1 can also be galvanized sufficiently without non-plated portions due to the contact of the metal wire 21 with the inner surface of the filler pipe 1. The auxiliary anode element 50 is particularly suitable to the case where the filler pipe 1 has a small diameter.

FIGS. 12 to 15 illustrate a fourth embodiment of the invention. An auxiliary anode element 60 employed in the fourth embodiment comprises the metal wire 21 and a plurality of insulating spacers 61 fitted with the metal wire 21. Each insulating spacer 61 is made of polypropylene (PP) into a shape as shown in FIGS. 13 and 14. More specifically, each insulating spacer 61 comprises an annular central plate 62 through which the metal wire 21 is inserted. Two annular end plates 63 is provided at both sides of the central plate 62. Each end plate 63 has a slightly smaller outer diameter than the central plate 62. Four frame plates 64 are provided to connect between the outer periphery of the central plate 62 and the inner face of each end plate 63. Each frame plate 64 has an outwardly projecting lengthwise central portion. The frame plates 64 are disposed at the intervals of 90

degrees. Thus, each insulating spacer 61 is formed into the shape of a barrel with relatively large peripheral openings 65 and the projecting central portion. Each insulating spacer may be made of another non-conductive material such as a ceramic material or polyethylene (PE).

The cylindrical cushion member 56 with elasticity is fitted with the proximal end of the metal wire 21. Thereafter, the plurality of insulating spacers 61 are sequentially fitted with the metal wire 21. The stopper 57 is finally fastened to the distal end of the metal wire 21 for preventing the insulating spacers 61 from falling off. Thus, the auxiliary anode element 60 is constituted including the insulating spacers 61 continuously fitted with the metal wire 21 as shown in FIG. 12. When the auxiliary anode element 60 is inserted into the filler pipe 1, the metal wire 21 is suitably curved between the insulating spacers 61 to be bent according to the bent form of the filler pipe 1, as shown in FIG. 15. The frame plates 64 of insulating spacers 61 are partially brought into contact with the inner surface of the filler pipe 1 and accordingly, the metal wire 21 is prevented from a direct contact with the inner surface of the filler pipe 1.

According to the fourth embodiment, the current flow distribution in the hollow interior of the filler pipe 1 is improved as in the first embodiment. Consequently, a sufficient coating thickness by the galvanization can be obtained. Furthermore, the inner surface of the filler pipe 1 can also be galvanized sufficiently without non-plated

portions due to the contact of the metal wire 21 with the inner surface of the filler pipe 1.

Although the invention has been applied to the galvanization of the filler pipe in the foregoing embodiments, the invention may be applied to the plating of other bent or curved pipes or tubes. Furthermore, the invention may be applied to various methods of electroplating other than the galvanization

The foregoing description and drawings are merely illustrative of the principles of the present invention and are not to be construed in a limiting sense. Various changes and modifications will become apparent to those of ordinary skill in the art. All such changes and modifications are seen to fall within the scope of the invention as defined by the appended claims.

CLAIMS:

1. A method of electroplating a tubular workpiece comprising the steps of:

inserting a flexible linear auxiliary anode element into a hollow interior of the workpiece so that the anode element is insulated from an inner peripheral surface of the workpiece;

immersing the workpiece and the anode element in a plating liquid reserved in a plating bath; and

applying voltage between the auxiliary anode element and the workpiece.

2. The method of claim 1, wherein an insulating spacer is attached to the auxiliary anode element so that a liquid penetrating space is defined between the auxiliary anode element and the inner peripheral surface of the workpiece, and the auxiliary anode element with the insulating spacer attached thereto is inserted into the workpiece.

3. An electroplating auxiliary anode element which is inserted into a tubular workpiece so that an inner surface of the workpiece is electroplated, the anode element comprising:

a flexible metal wire connected to the anode element; and

a liquid penetrating insulating spacer attached to the metal wire.

4. An auxiliary anode element of claim 3, wherein the metal wire is formed by stranding thin wires of stainless steel together and has a connecting terminal on an end thereof.

5. An auxiliary anode element of claim 3, wherein the insulating spacer comprises an insulating tube fitted with a periphery of the metal wire, and the insulating tube has a number of liquid penetrating openings.

6. An auxiliary anode element of claim 3, wherein the insulating spacer is formed into the shape of a helical coil fitted with the periphery of the metal wire over an overall length thereof.

7. An auxiliary anode element of claim 3, wherein a plurality of the insulating spacers formed of a plastic material are attached to the metal wire, and each insulating spacer includes a plurality of annular plates fitted with the periphery of the metal wire and a plurality of frame plates formed integrally with the annular plates so as to extend axially with respect to the metal wire to thereby connect the annular plates together.

8. An auxiliary anode element of claim 7, wherein the annular plates are disposed at a center and both axial ends of the insulating spacer, and the annular plate disposed

at the center of the insulating spacer has a larger diameter than the annular plates disposed at the respective ends of the insulating spacer.

9. An auxiliary anode element of claim 4, wherein the insulating spacer comprises an insulating tube fitted with a periphery of the metal wire, and the insulating tube has a number of liquid penetrating openings.

10. An auxiliary anode element of claim 4, wherein the insulating spacer is formed into the shape of a helical coil fitted with the periphery of the metal wire over an overall length thereof.

11. An auxiliary anode element of claim 4, wherein a plurality of the insulating spacers formed of a plastic material are attached to the metal wire, and each insulating spacer includes a plurality of annular plates fitted with the periphery of the metal wire and a plurality of frame plates formed integrally with the annular plates so as to extend axially with respect to the metal wire to thereby connect the annular plates together.

12. An auxiliary anode element of claim 11, wherein the annular plates are disposed at a center and both axial ends of the insulating spacer, and the annular plate disposed at the center of the insulating spacer has a larger diameter than the annular plates disposed at the respective ends of

the insulating spacer.

METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN

ABSTRACT OF THE DISCLOSURE

A method of electroplating a tubular workpiece includes the steps of immersing the workpiece and an anode element in a plating liquid reserved in a plating bath, inserting a flexible linear auxiliary anode element into a hollow interior of the workpiece so that the anode element is insulated from an inner peripheral surface of the workpiece, and applying voltage between the auxiliary anode element and the workpiece.

Fig. 1

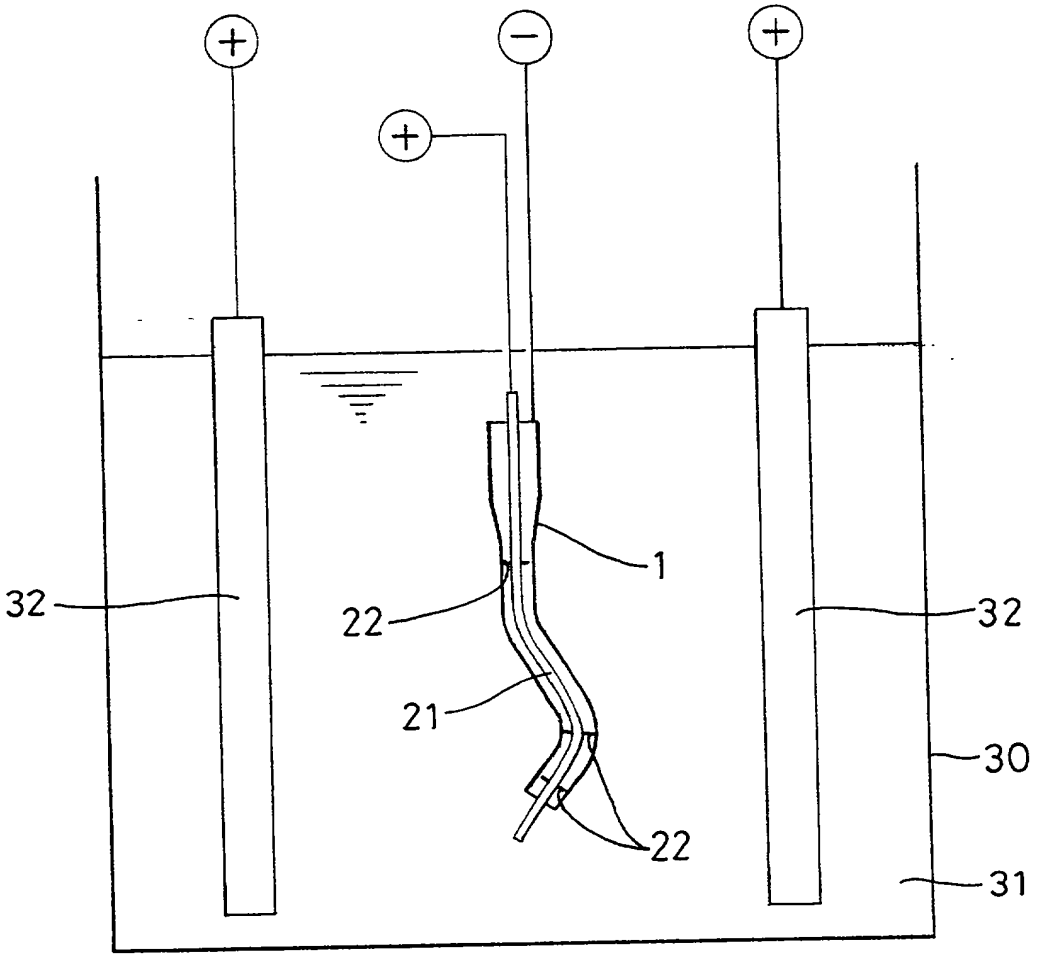


Fig. 2

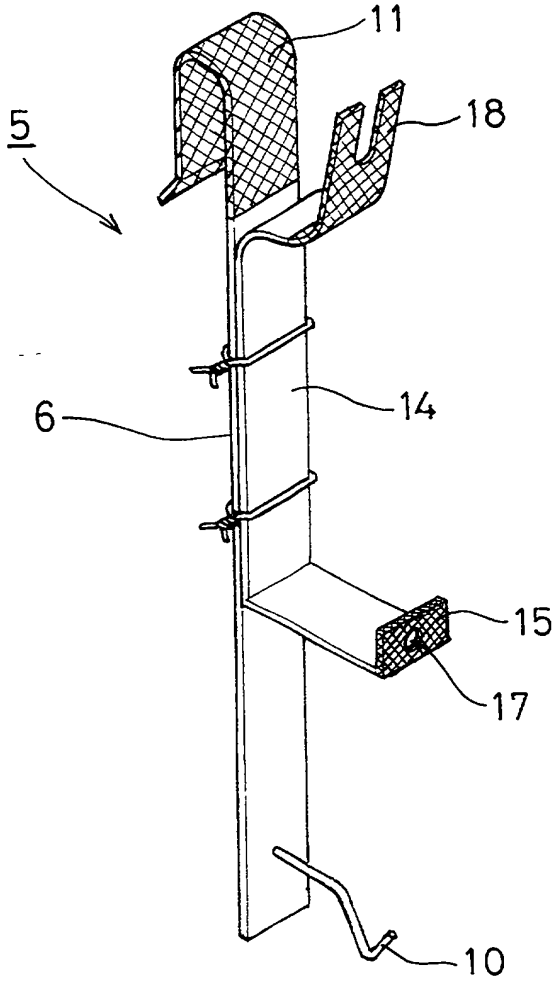


Fig. 3

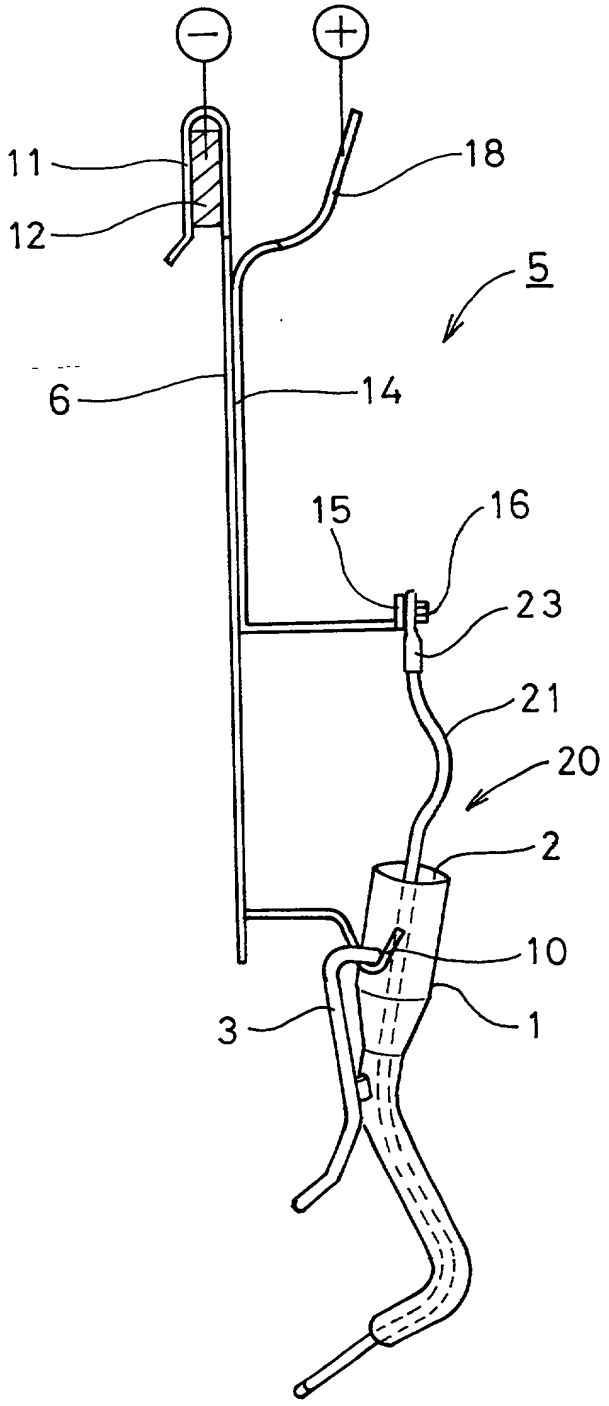


Fig. 4

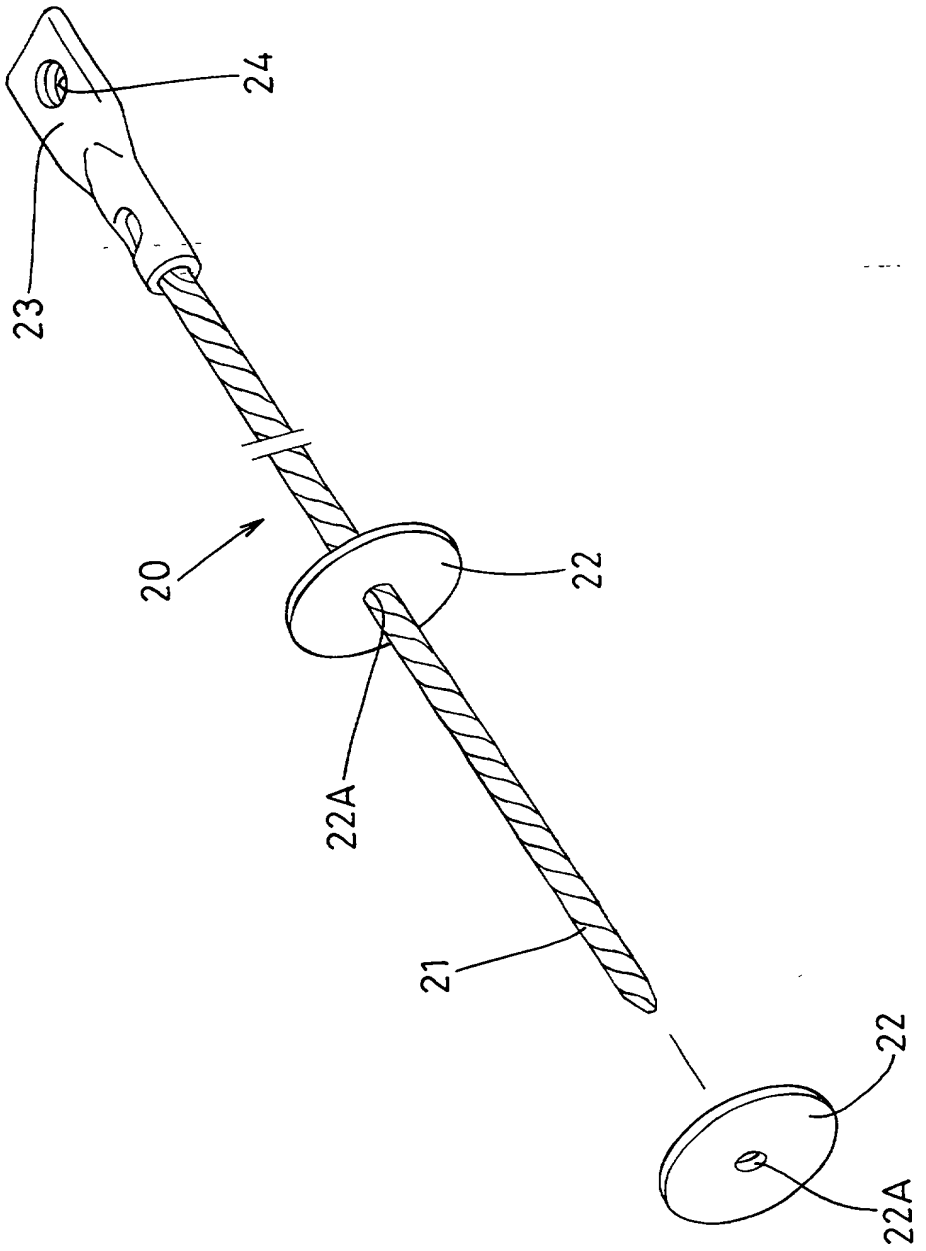


Fig. 5

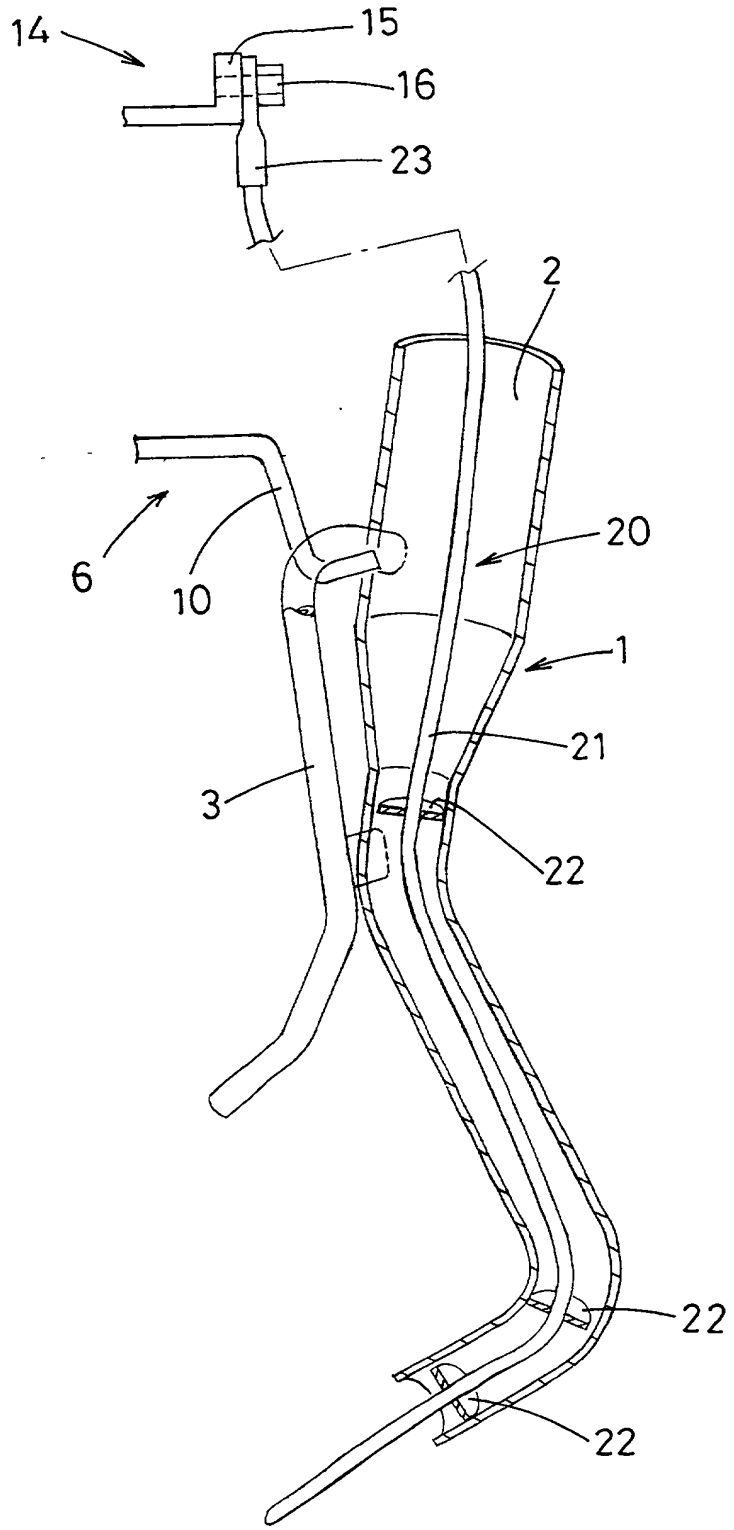


Fig. 6

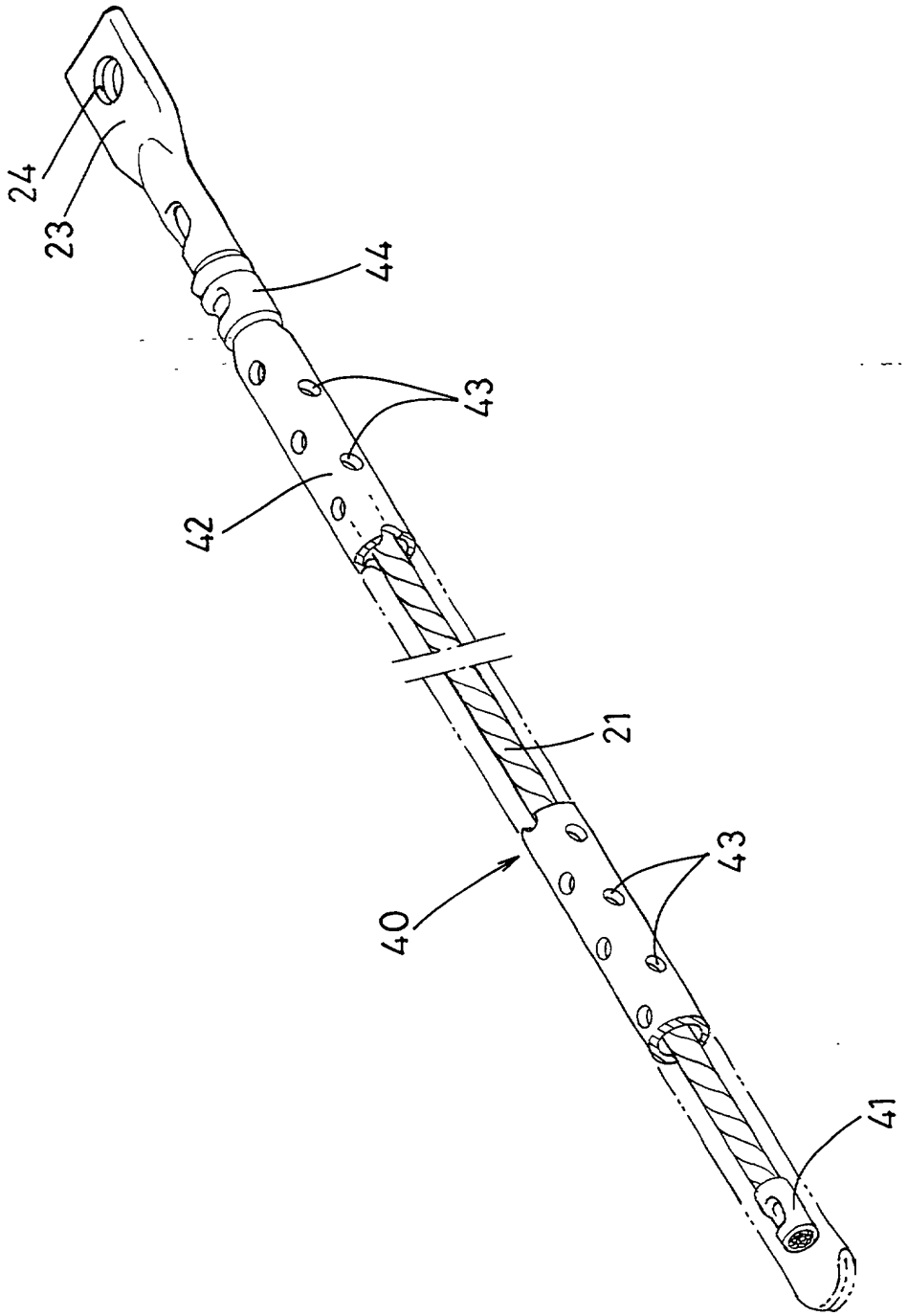


Fig. 7

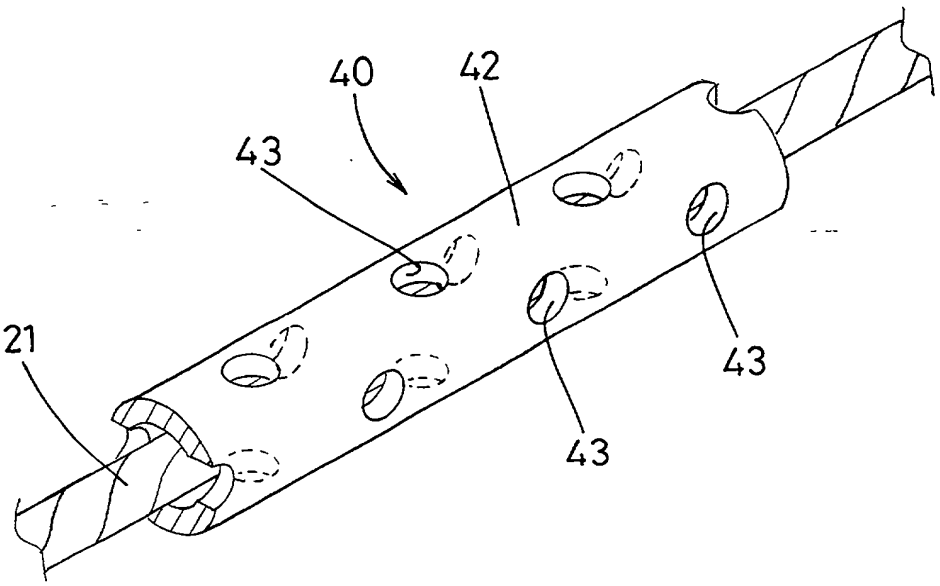


Fig. 8

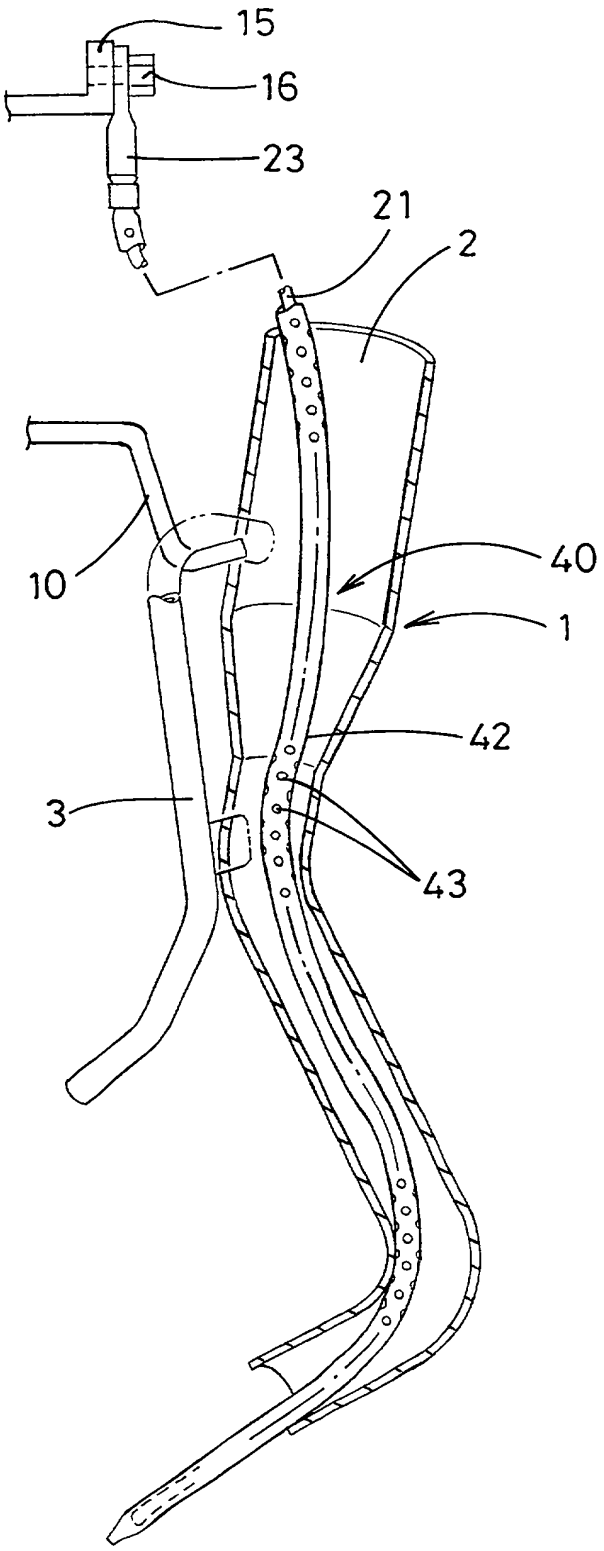


Fig. 9

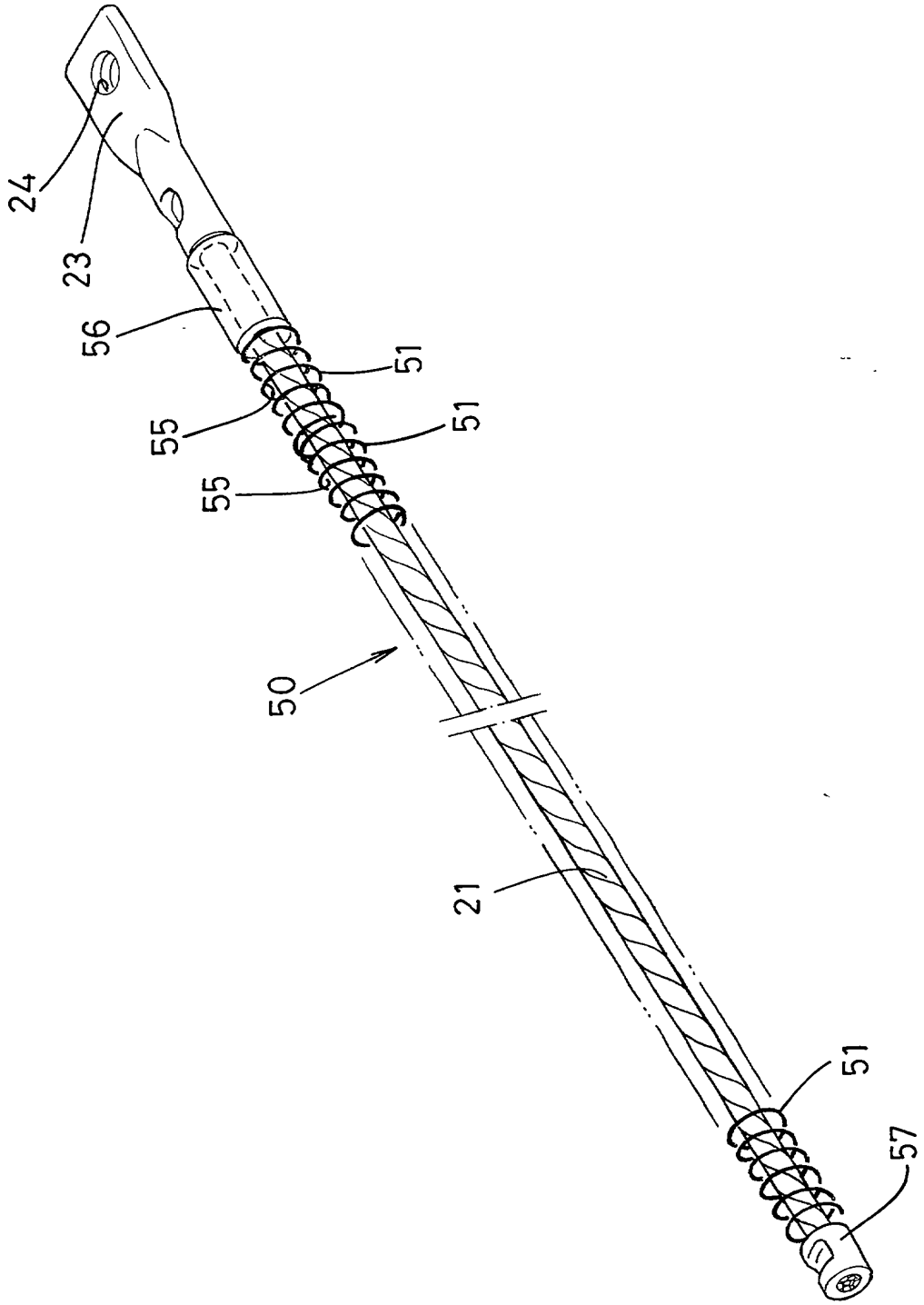


Fig. 10

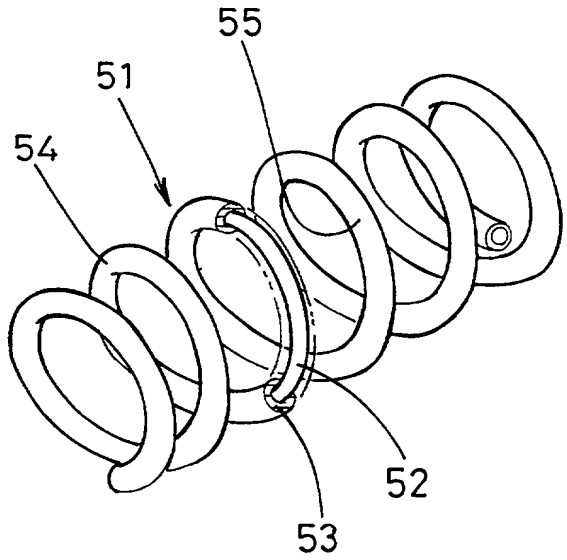


Fig. 11

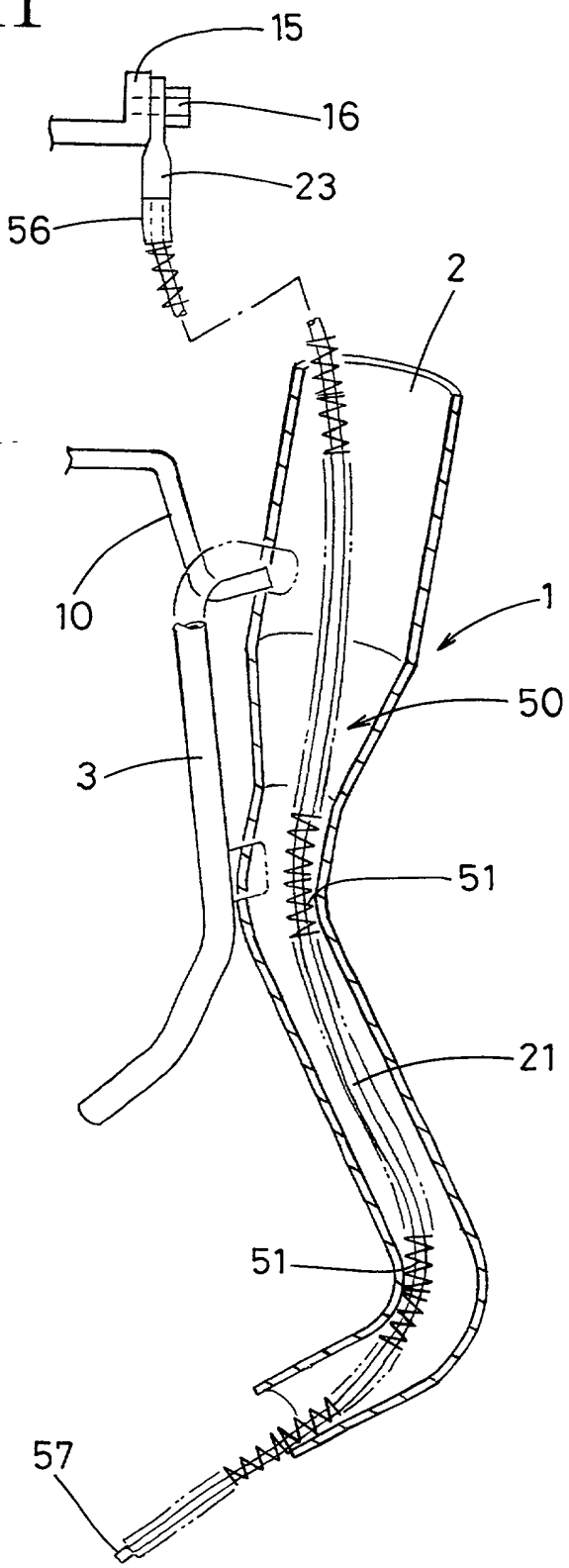


Fig. 12

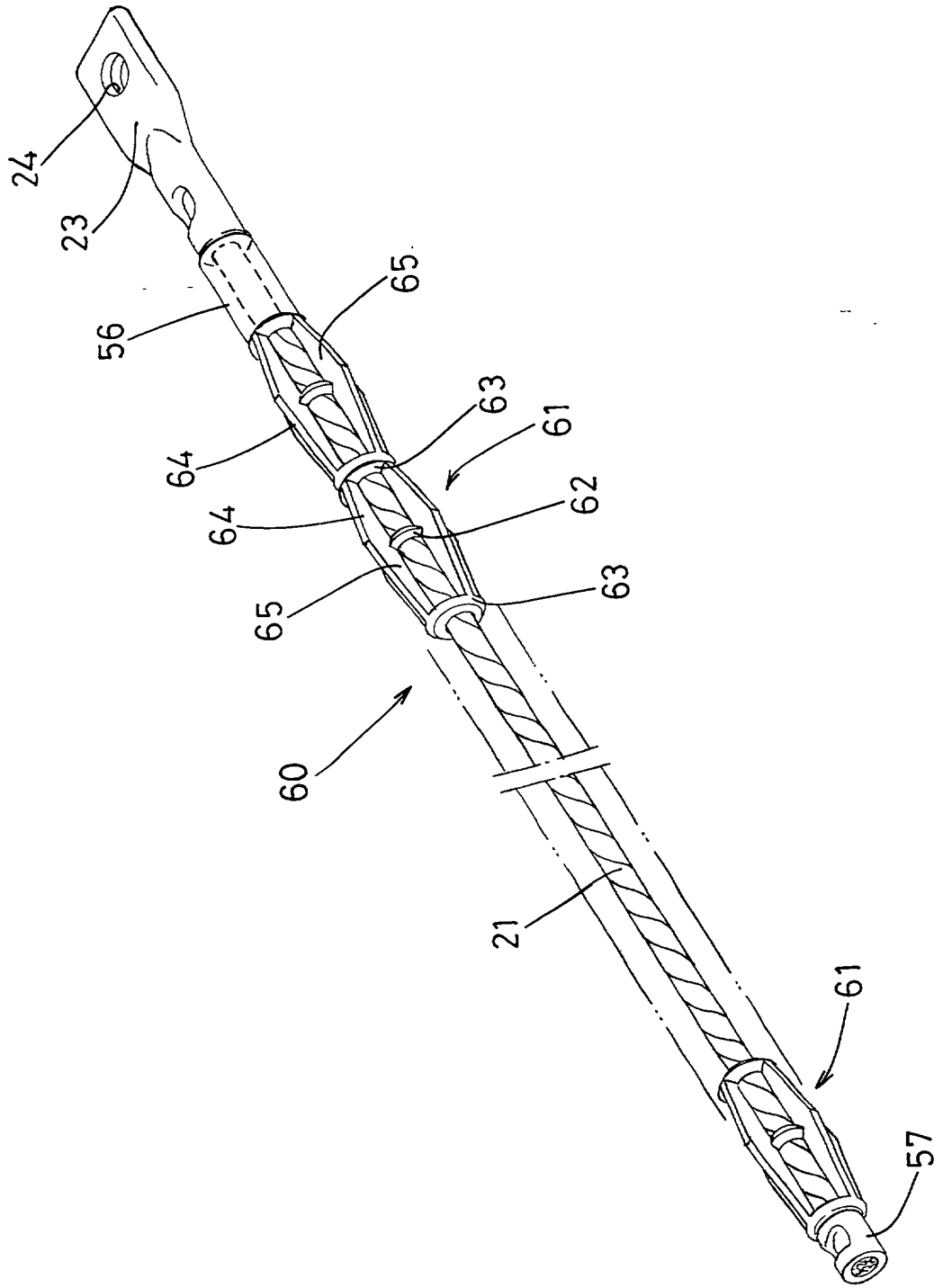


Fig. 13

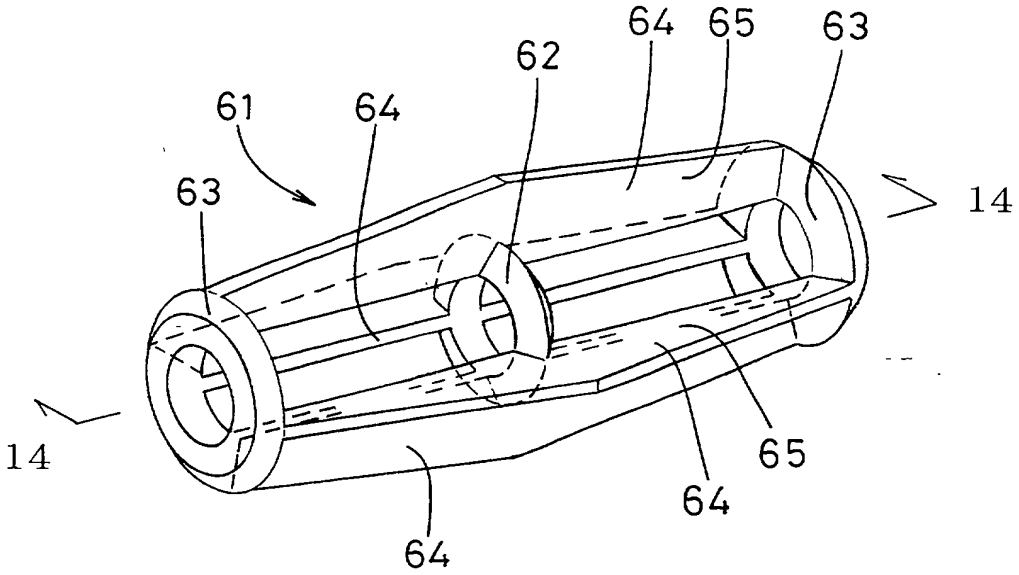


Fig. 14

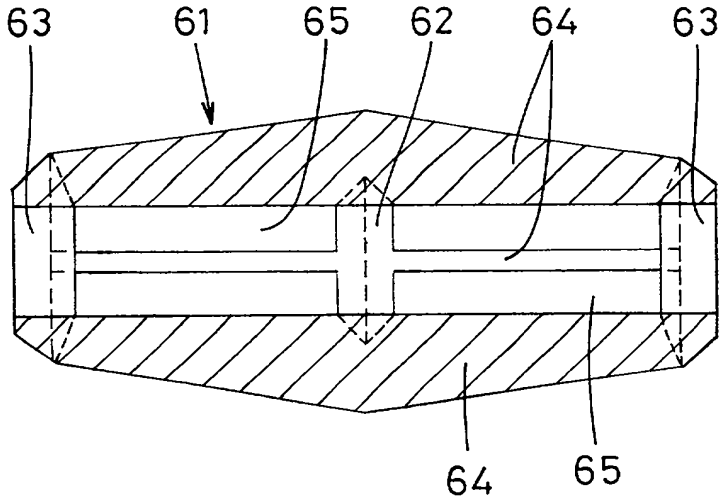
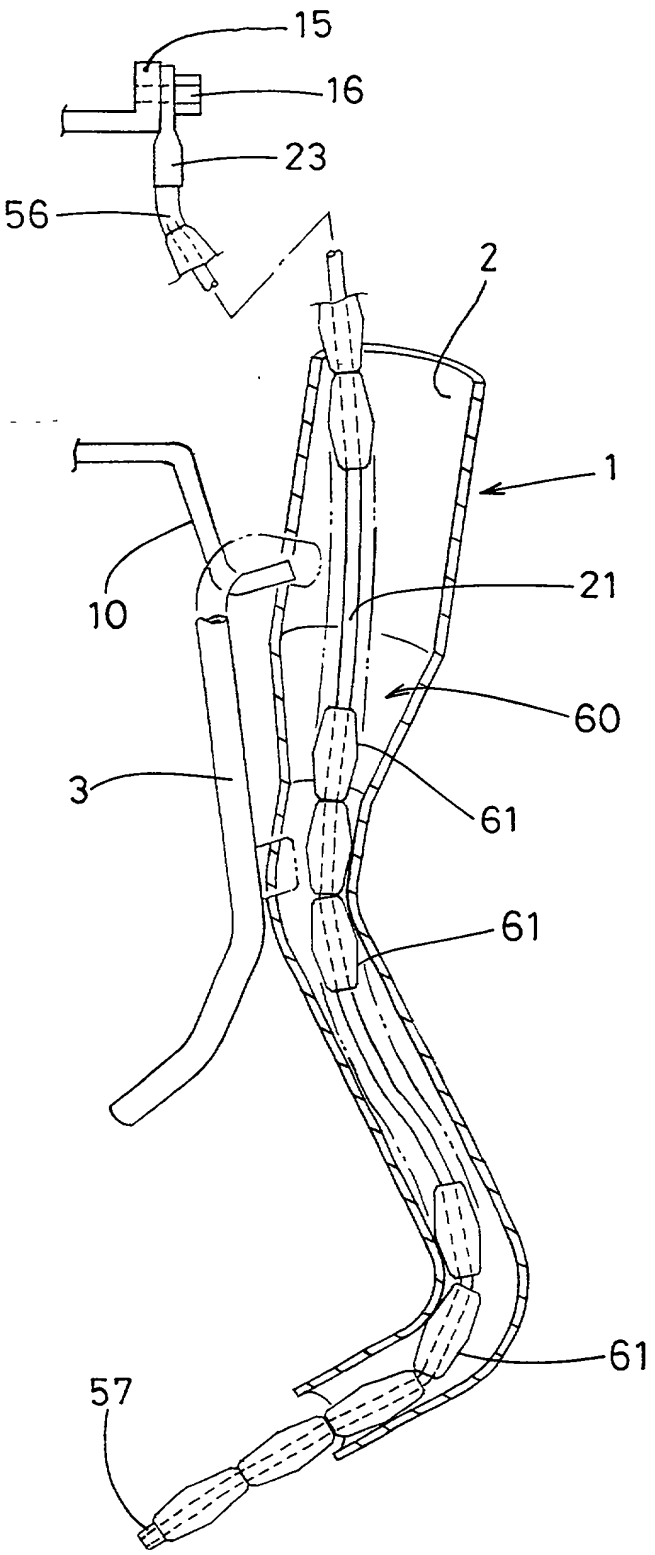


Fig. 15



DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

( ) Original ( ) Supplemental ( ) Substitute ( ) PCT ( ) Design

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN

of which is described and claimed in:
( ) the attached specification, or
( ) the specification in the application Serial No. _____ filed _____;
and with amendments through _____ (if applicable), or
( ) the specification in International Application No. PCT/ _____, filed _____, and as amended on _____ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
Japan	9-112911	April 30,1997	Yes

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not dislcosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint John T. Miller, Reg. No. 21,120; Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Jeffrey Nolton, Reg. No. 25,408; Warren M. Cheek, Jr., Reg. No. 33,367; Nils E. Pedersen, Reg. No. 33,145 and Charles R. Watts, Reg. No. 33,142, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from _____ as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

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Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
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Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
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Full Name of Fourth Inventor	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE

Full Name of Fifth Inventor	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE
Full Name of Sixth Inventor	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE
Full Name of Seventh Inventor	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE

I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1st Inventor Chikanori Mizuno Date 31 March 1998

2nd Inventor _____ Date _____

3rd Inventor _____ Date _____

4th Inventor _____ Date _____

5th Inventor _____ Date _____

6th Inventor _____ Date _____

7th Inventor _____ Date _____

The above application may be more particularly identified as follows:

U.S. Application Serial No. _____ Filing Date _____

Applicant Reference Number Z7041DBA Atty Docket No. _____

Title of Invention METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	
Chikanori MIZUNO	:	
Serial No.	:	**Attn: Application Branch**
Filed April 28, 1998	:	**Attorney Docket No. 998/Z7041DBA**
METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN	:	

COVER LETTER RE: DECLARATION SUPPORTING CLAIM FOR SMALL ENTITY STATUS

Assistant Commissioner for Patents,
Washington, D.C.

Sir:

Submitted herewith is a Declaration Supporting Claim for Small Entity Status in the subject application.

Respectfully submitted,

Chikanori MIZUNO

By _____
Nils E. Pedersen
Registration No. 33,145
Attorney for Applicant

NEP/knw
Washington, D.C.
Telephone (202) 721-8200
April 28, 1998

DECLARATION SUPPORTING CLAIM FOR SMALL ENTITY STATUS

The undersigned hereby declare(s) that this statement is made to support a claim by the below identified entity for purposes of paying reduced fees under Sections 41(a) and (b) of Title 35, United States Code, with regard to an invention entitled METHOD OF ELECTROPLATING TUBULAR BENT WORKPIECE AND AUXILIARY ANODE ELEMENT SUITABLE FOR USE THEREIN, invented by Chikanori MIZUNO and described in

[X] the specification filed herewith.
[ ] application Serial No. ____________, filed ____________.
[ ] Patent No. ____________, issued ____________.

[ ] a. I am/we are the inventor(s) of the above-identified application.

[ ] b. I/we would qualify as (an) independent inventor(s) as defined in 37 C.F.R. 1.9(c) if I/we had made the above-identified application, and rights under contract law with regard to the above-identified invention have been conveyed to and remain with me/us.

[X] c. I am [ ] the owner
[X] an official of the below-identified small business concern; rights under contract law with regard to the above-identified invention have been conveyed to and remain with the below-identified small business concern; and this concern qualifies as a small business concern as defined in 13 C.F.R. 121.3-18, and reproduced in 37 C.F.R. 1.9(d), for purposes of paying reduced fees under sections 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons, said number being determined and said affiliates being defined in 13 C.F.R. 121.3-18.

No rights in the invention have been assigned, granted, conveyed or licensed or further assigned, granted, conveyed or licensed, and there is no obligation under contract or law to assign, grant, convey or license, or further assign, grant, convey or license such rights to any person who could not be classified as an independent inventor under 37 C.F.R. 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 C.F.R. 1.9(d) or a nonprofit organization under 37 C.F.R. 1.9(e).

Each person, concern or organization to which any rights in the invention have been assigned, granted, conveyed, or licensed or further assigned, granted, conveyed, or licensed or further assign, grant, convey or license, or as to where there is an obligation under contract or law to assign, grant, convey, or license such rights is listed below:

[ ] no such person, concern, or organization
[ ] persons, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 C.F.R. 1.27)

FULL NAME ____

ADDRESS ____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

FULL NAME ____

ADDRESS ____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I/we acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 C.F.R. 1.28(b))

I/we further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon, or any patent to which this declaration is directed.

NAME _____ SIGNATURE _____ DATE _____

NAME _____ SIGNATURE _____ DATE _____

Daiwa Excel Co., Ltd. of 1-24 Kanarebashi 1-chome, Chikusa-ku, Nagoya, AICHI, JAPAN
NAME OF SMALL BUSINESS CONCERN ADDRESS

NAME Chikanori MIZUNO SIGNATURE Chikanori Mizuno DATE 28 Apr. 1998

President
TITLE